



Reflexões acerca da Etnobiologia e Etnoecologia no Brasil

Roque Ismael da Costa Güllich
(Organizador)

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APRESENTAÇÃO

Etnobiologia um novo ramo da biologia que vem se consolidando com aporte na ecologia humana e na antropologia que tem como cerne a perspectiva etnográfica na sua constituição, ou seja: o conhecimento adquire fluidez a partir do campo empírico, da cultura, do diálogo entre saberes.

Assim, como vai sendo constituída vai se consolidando como Ciência, como campo de pesquisa e como prática. Basicamente primando pela pesquisa científica, pelo diálogo, mas acima de tudo pela escuta do sujeitos envolvidos nos processos, a Etnobiologia sugere a Ciência um novo contrato social e pedagógico. Este outro e diferente modo de pesquisar, ou seja, ouvindo, resgatando e dialogando com comunidades locais, afim de conhecer-na-ação, através de pesquisa participante e com isso comprometida socialmente e apropriando-se dos estilos do coletivo cultural que conhece e estabelece os processos cotidianos.

A perspectiva de pesquisa que se inicia através do conhecimento de realidades e se processa no embate com as discussão e sistematizações teóricas acadêmicas não se descuida, com isso, do método científico, mas aposta nele através de um dimensão histórico-cultural, como forma produção e natureza do conhecimento científico.

A Etnobiologia além de fazer a escuta social dos coletivos de pensamento, das percepções humanas acerca da natureza que os rodeia e de perceber a dialética que a prática e a teoria possibilitam ler na perspectiva da práxis, toma para si a necessidade da ciência moderna de perceber o outro, que é o sujeito do conhecimento, e então apura-se no intento de ao pesquisar o sujeito do mundo cotidiano possibilitar a ele e a ciência o conhecimento da natureza e emanar desta relação as necessidades de se conhecer para preservar.

De posse dos etnoconhecimentos constituídos ao longo da história da humanidade a Ciência Biológica pode facilitar outros diálogos de saberes, em especial com a Cultura, com a Ciências e com a Sociedade, no que pese pela educação, ou seja, com o ensino de Biologia e Ecologia, pois interdisciplinaridade é um eixo na etnobiologia e assim, é também necessária a ela a interpersoalidade, pois é nela que se estabelece interação e diálogo.

Neste contexto, a Sociedade, as Instituições de Ensino e de Pesquisa ganham uma nova ferramenta a etnobiologia/etnoecologia como modo/forma de articular o que sabemos, aprendemos e ensinamos a partir da realidade das comunidades, resgatando o conhecimento local, educando pela pesquisa e ressignificando conceitos e práticas culturais a luz dos conhecimentos da(s) Ciência(s) na perspectiva da produção conceitual de conhecimentos biológicos/ecológicos.

Acredito que a deixa é esta, pois quando a Sociedade, a Cultura e a Ciências se reconhecem como modo de produção e moradia para o conhecimento, perceberemos novas relações tecidas no âmbito da cultura e convívio social, entendendo que a interlocução entre os diferentes sujeitos constitui pensamento e linguagem. Constroem-

se assim, novos saberes, novos diálogos, propósitos, projetos e práticas que nos (re)educam na interação entre cotidiano da experiência social, cultural e científica.

O livro que ora apresentamos está recheado de sentidos e significados em 14 diferentes capítulos que dispõe conhecimentos biológicos, ecológicos, culturais, narrativas, educação, meio ambiente, que com suas diferentes facetas compõe a Etnobiologia de um tempo presente, que respeita o passado cultural de nosso povo e prospecta cada vez mais um futuro científico multicultural.

Assim, a Etnobiologia vem ao encontro dos anseios sociais e científicos, com nuances e estilos que possibilitam performances outras, novas leituras e formas de ensinar, pesquisar, como fenômeno discursivo e de ação propiciado pela interação, pelo envolvimento que a ferramenta etno nos apresenta e nos faz apropriar. Com isso, cultura, sociedade, pesquisa, ciência, ensino e biologia/ecologia ganham em forma e (re)forma, com o desenvolvimento de possibilidades novas e outras neste advento contemporâneo: que se envolve e apercebe também da ética e da estética no contexto e argumento maior do planeta: a sobrevivência da Terra.

O livro é um convite ao diálogo entre distintos saberes, bem como uma coletânea de aprendizagens que ora se dispõe a leitura e crítica da comunidade científica e em geral.

Boa Leitura,

Prof. Dr. Roque Ismael da Costa Güllich

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FISHERMEN KNOWLEDGE ON BOTOS TO SUPPORT MANAGEMENT STRATEGIES IN THE MIDDLE TAPAJÓS RIVER, BRAZIL

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ABSTRACT: The Amazon River dolphin or “boto” (*Iniageoffrensis*) is a cetacean whose populations are increasingly vulnerable to exploitation by fishermen for bait, genetic isolation, habitat change and river impoundment by dams. This study presents an analysis of knowledge held by local fishermen from the Tapajós River regarding interactions between botos and fisheries, as well as perceived threats to these cetaceans,

to inform conservation strategies. Through participant observation and semi-structured interviews with 20 artisanal fishermen, we found that fishermen hold comprehensive knowledge of boto populations, do not consider fisheries as significant threats to river dolphins (95%), but mentioned incidental catches in fishing nets. The majority of interviewed identified the construction of hydroelectric dams as the greatest threat to botos in the region (30.7%). Fishermen knowledge should be considered in the design of management strategies of boto populations, as well as for the maintenance of artisanal fishing in the Amazon.

KEYWORDS: Amazon River dolphin, Fisheries, Hydroelectric Dams, Local Knowledge

1 | INTRODUCTION

In the Brazilian Amazon, the Middle Tapajós River hosts a mosaic of protected areas, indigenous lands and rural communities, which livelihoods are closely tied to forest-river ecosystem dynamics. Livelihood strategies are largely based on fisheries, given the diversity and abundance of fisheries resources, linked to the cultural background of indigenous and riverine populations (ALHO et al., 2015; FEARNESIDE, 2015a; MACEDO & CASTELLO, 2015). The connectivity and sustainability of these bio-

cultural systems are nevertheless under unprecedented threat by large-infrastructure projects planned for the Amazon rivers by the Brazilian government in the next decades (FINER & JENKINS, 2012; MACEDO & CASTELLO, 2015; WINEMILLER et al., 2016), including an integrated system of hydroelectric dams, hydroways, ports and roads. Management and conservation strategies for these vulnerable bio-cultural systems need to take into consideration local knowledge and livelihoods, and consider basin-wide scales (FINER & JENKINS, 2012; WINEMILLER et al., 2016).

Artisanal fishermen hold experiential knowledge of the biology and ecology of diverse fish species in the Amazon, many of which have been insufficiently studied by Western science (DIEGUES, 2000; DORIA et al., 2012, 2014). Fishermen knowledge on cetaceans may contribute to fill in a current gap of information on these populations' biological and ecological traits (SMITH & REEVES, 2012), as well as provide a better understanding of the nature and extent and of potential anthropogenic threats and impacts to these populations (PINHEIRO & CREMER, 2003; SOUZA & BEGOSSI, 2007).

The basins of the Amazon and Orinoco rivers are home of one endemic species of cetacean, the boto or Amazon River dolphin *Inia geoffrensis* (Figure 1). The animal occurs in six South American countries (Bolivia, Brazil, Colombia, Ecuador, Peru, Venezuela), as well as along the Branco and Tacutu Rivers on the border between Brazil and Guyana (BEST & DA SILVA, 1993; ALIAGA-ROSSEL, 2002).



Figure 1. The Amazon River dolphin or boto (*Inia geoffrensis*).

In Brazil, botos are impacted by different threats, including the use of their carcasses as bait in fishing activities, wholesale slaughter due to conflicts with fishing activities, accidental capture and death by fishing nets, increase in the traffic of ships, loss and degradation of habitats, mortality in oil exploration projects and construction of waterways and dams, and an increase in potentially harmful tourist activities (ALVES et al. 2012, BRUM et al. 2015, DA SILVA & MARTIN 2010, GOMEZ-SALAZAR et al. 2012, HOLLATZ et al. 2011, IRIARTE & MARMONTEL 2013, MINTZER et al. 2015, VIDAL

2011, VIDAL et al. 2017). Considering these threats, in 2014 *Inia geoffrensis* was listed as Endangered by the Brazilian list of threatened species (MMA, 2014), although globally the genus is classified by IUCN as data deficient (REEVES et al., 2011).

The Tapajós River, a major right bank tributary of the Amazon River, has been targeted by the Brazilian government as the most recent and active “hydroelectric frontier”, with around 42 large hydropower projects planned or under construction for the states of Pará, Mato Grosso and Amazonas (FEARNSIDE, 2015b; MACEDO & CASTELLO 2015). Considering the impacts of other hydropower plants installed in the Amazon region, it is highly likely that this new complex will not only affect the hydrological dynamics and the areas used by human inhabitants, but will also strongly impact various groups of aquatic fauna, especially fish communities and cetaceans populations.

This article reports the results of an exploratory study focused on fishermen perceptions regarding the interactions of boto with fisheries, as well as the perceived threats to the species in the Middle Tapajós River, north of Brazil. We present data and information on boto ethnobiology and ecology, as well as research directions and proposed conservation strategies for these vulnerable cetacean populations.

2 | MATERIALS AND METHODS

2.1 Study area

The study was conducted in the communities of Pimental and Vila Rayol, on the Middle Tapajós River, state of Pará, Brazil (Figure 2). The Tapajós River rises in central Brazil, and empties into the Amazon River, near the city of Santarém (SIOLI, 1985). It is classified as a clear water river, with a low amount of suspended material and consequent low productivity. In its upper and middle sections, the Tapajós has substantial rapids, and islands formed by the accumulation of crystalline sediments derived from the Central Brazilian shield. These are deposited in the form of shoals, and the sedimentation of material originally carried by rain into the river bed (SIOLI, 1985).

The Tapajós watershed has 494 fish species recorded so far. The predominant group is formed by species occurring in the Amazonian lowlands (36% of the species), followed by endemic species (17%) and species typical of rivers crystalline shields (15% of the species). The endemic species are concentrated in the stretch of rapids in the Pimental region and in the upper portion of the basin, including the Teles Pires River and especially in the Juruena sub-basin (LUCENA, 2003; BERTACO & GARUTTI, 2007; VARI & CALEGARI, 2014).

The Pimental community is located on the right bank of the Tapajós River and is part of the Trairão municipality. Access to the community is by land, through unpaved

roads that connect the locality with the Santarém-Cuiabá highway (BR 163) and the Trans-Amazon highway (BR-230). Vila Rayol is situated on the left bank of the Tapajós River, next to the Amazonia National Park, and belongs to the municipality of Itaituba. Access to the community can be both by the river and through the Trans-Amazon highway.

A little over six hundred people live in the community Pimental and about a hundred inhabitants reside in Vila Rayol. Livelihood strategies of both localities include a mix of agriculture, livestock, fisheries and, to a lesser extent, commercial activities and services. Fishing activities ensure not only food security, but also individual and family incomes above the average found for Pará rural areas (CNEC, 2014). The communities do not have access to sewage and water treatment services, as well as garbage collection.

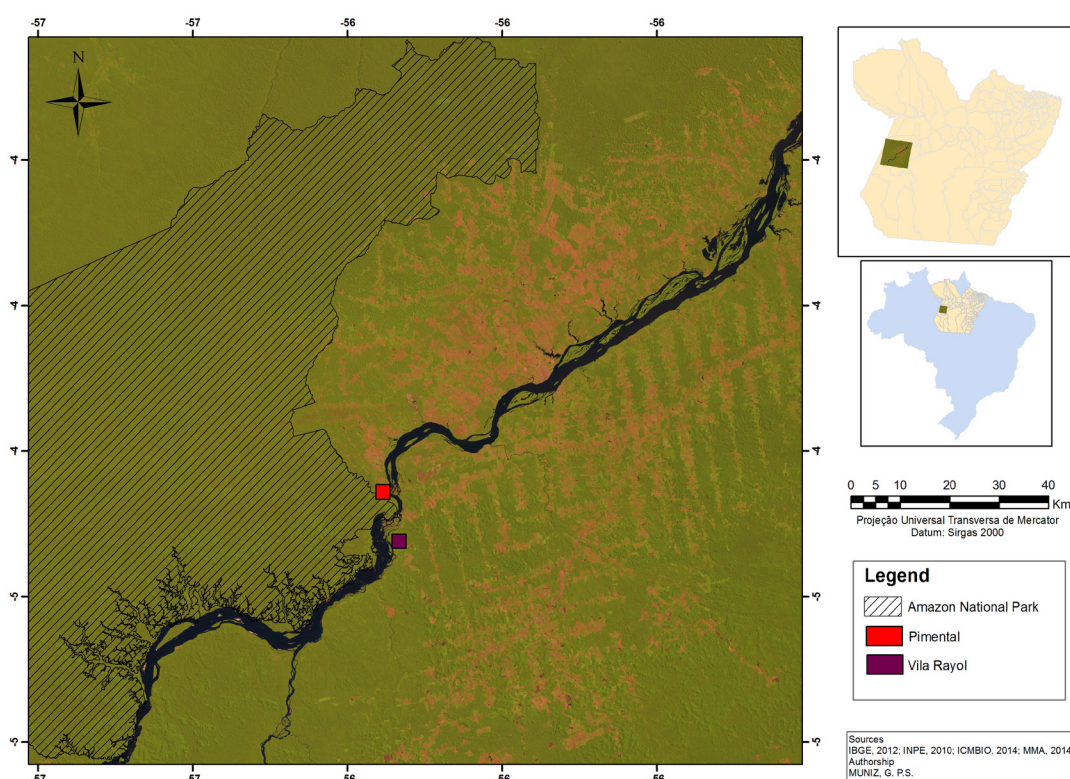


Figure 2. Map of the Middle Tapajós River identifying the location of participating communities Pimental and Vila Rayol, Pará State, north of Brazil.

2.2 Data collection and analysis

Data collection occurred during two field expeditions, undertaken during the second half of 2012. Research methods included direct observation and conduction of semi-structured interviews with 20 local fishermen, being 10 from Vila Rayol and 10 from Pimental localities. This sample size related to the interviewee fishermen is considered efficient to ethnobiological surveys and other studies used similar sample size (SOUZA & BEGOSSI, 2007; ZAPPES et al., 2013; ALVES et al., 2012). The small number of interviews carried out with the local fishermen is justified by the fact that the

same pattern of responses became apparent after the 10th interview (ZAPPES et al., 2016).

Two methods for choosing interviewees were used. The selection of the first fishermen respondent was made with the aid of the community's president, since usually this is the person who knows best the community members. From the second respondent on, the snow-ball method was used in which participants indicate the next potential respondent, indicating people who were knowledgeable about the topic under investigation (ZAPPES et al., 2013).

Like Zappes et al. (2011b, 2016), the interviews were conducted in a local considered appropriate for the respondent (home, community center, community port) and the researcher presented herself as a member of a research institution to avoid associations on the part of the fishermen with authorities or environmental regulatory agencies. The interview form included the following topics: fisherman's profile (age, gender, time spent fishing, socio-economic characteristics), local knowledge on boto and its interactions with fisheries (what kind of animal is the dolphin, when is the best time of year to see it, what types of fish do they eat, using boto for any activity, problems that dolphins cause to fishing), and conservation (threats to the boto in the region, importance of boto in nature, the importance of protecting them).

Responses were coded and grouped in categories. The questions that allowed the interviewee to give only one response were analyzed by percentage calculations (descriptive statistics). Topics for which the respondents could provide more than one answer were analyzed by the frequency of citations, considering the number of times that these topics appeared among the total of responses. The open questions were treated descriptively (ALVITE et al., 2014).

This study was developed by National Center for Research and Conservation of Sociobiodiversity Associated with Traditional Peoples and Communities - CNPT/ICMBio, and was approved by both the local communities and by the research committee of the governmental institution.

3 | RESULTS AND DISCUSSION

3.1 Fishermen profiles

Fishermen participating in this study were all male, which corroborates the results of other studies (ALVES et al., 2012; BRITO, 2012) that describe fishing in the Amazon as mainly performed by men, especially in relation to knowledge on botos. The fact that no women was indicated to participate in the interviews might also be related to cultural specificities and taboos related to the boto, which are still present among Amazonian riverine communities (MINTZER et al., 2015) and discussed in the next sections.

The age of respondents ranged from 18 to 70 years, with the predominant age

group being 48-57 years (40.0%). This age range is like that found by Brito (2012) in a research on local ecological knowledge and interaction with the dolphins by fishing communities in the municipalities of Colares and Soure, in the state of Pará. In the Brazilian Amazon, the knowledge of artisanal fishing practices is generally transmitted within the nuclear family, when young individuals accompany their parents in fishing trips, often made daily to the rivers and lakes close to their places of residence.

Fourteen participants (70.0%) said that they have practiced fishing for over 20 years. This indicates that these fishermen hold a long time experiential knowledge on fisheries, and that they normally start to develop the activity at a young age, before adulthood.

3.2 Aspects of boto ethnobiology and interactions with fisheries

Fourteen respondents (66.6%) considered the boto to be a fish, five other respondents (23.8%) considered the animal to “half-fish, half-flesh”, and only one considered the boto as flesh (9.6%). According to Oliveira e Monteiro-Filho (2006), the fact that fishermen primarily use the term ‘fish’ for boto shows that the designation is directly related to where the organism lives. This is supported by several studies showing that the ‘fish’ way of life, may be used to characterize different groups of vertebrates that live in aquatic habitats, including fish, turtles, crocodiles, dolphins and whales (HUNN, 1982; BERKES et al., 2000; PINHEIRO & CREMER, 2003; SOUZA e BEGOSSI, 2007; THOMPSON et al., 2013).

According to seven respondents (35.0%), the best time to observe botos in the region is during the low water or dry season. Another six fishermen (30.0%) said that the best period was when the water was rising. Only three respondents (15.0%) said the best period was during the high water. In a study on the Pará coastal region, Brito (2012) reports that the time of the year when fishermen most often saw boto is during the rainy season (December to May), which coincides with the flooding or raising of water levels for Amazonian rivers. Dolphins might also be seen during the dry period, since this is the breeding season for many fish species, especially the Characiformes, an important group of fish eaten by boto (BEST & DA SILVA, 1993). During this period, large schools migrate near the riverbanks, attracting both botos and fishermen.

The number of fish ethnospecies (popular designations that might refer to more than one scientific species) that each fisherman identified as preys of boto ranged from one to five, totaling 18 ethnospecies (or species group), presented in Table 1. Although in our study only 18 species (or species groups) of fish were mentioned by the fishermen, it is probable that the number of species caught by boto is larger, and that the respondents mentioned only the most common.

Popular names	Scientific names	N of descriptions	% of descriptions	% of interviewees
Jaraqui	<i>Semaprochilodus</i> spp.	11	17.18	55.00
Aracu	<i>Leporinus</i> spp.	8	12.50	40.00
Pacu	<i>Myleus</i> spp.	7	10.93	35.00
Piau	<i>Schizodon fasciatus</i>	6	9.37	30.00
Curimatã	<i>Prochilodus nigricans</i>	5	7.81	25.00
Tambaqui	<i>Colossoma macropomum</i>	5	7.81	25.00
Dourada	<i>Brachyplatystoma rousseauxii</i>	4	6.25	20.00
Filhote	<i>Brachyplatystoma filamentosum</i>	3	4.68	15.00
Pescada	<i>Plagioscion squamosissimus</i>	2	3.12	10.00
Matrinxã	<i>Brycon amazonicus</i>	2	3.12	10.00
Surubim	<i>Pseudoplatystoma fasciatum</i>	2	3.12	10.00
De couro	Many species of catfish	2	3.12	10.00
Fish with scales	Many species	2	3.12	10.00
Others	Many species	5	7.80	25.00
Sum		64	100	-----

Table 1. Species of fish (or popular designations that refer to more than one species) that boto eat, according to respondents in the Middle Tapajós River, Pará, Brazil.

Boto are known to feed on 43 species of fish from 19 families (BEST & DA SILVA, 1993): Sciaenidae, Cichlidae and Curimatidae are their preferred prey. Many species of these families are economically important and are a focus of artisanal fisheries in the Amazon region, which indicates the potential for competition between botos and artisanal fishermen for some fish species. Alves et al. (2012) identified 16 fish species as targets of fishermen in the Amazonas state, most of them previously described as targets of botos (BEST & DA SILVA, 1989).

Eighteen respondents (90.0%) reported not using boto for any purpose. However, it is noteworthy the fact that two respondents reported the use of boto meat for food. In the study conducted by Alves *et al.* (2012) in Manacapuru, Amazonas State, 10 respondents (62.5%) described the use of dolphin meat for human consumption, and of these 10 respondents, seven (43.7%) said that they had eaten boto meat.

Many Amazonian indigenous and traditional communities avoid killing botos or using parts of their bodies. This is related to beliefs and taboos that exist around this animal across the Amazon. According to a folk legend, botos are enchanted animals, who at night can transform into a beautiful young man and seduce women (CRAVALHO, 1999; GRAVENA et al., 2008; DUTRA & BARBI, 2014). Killing a boto

may result in bad luck to a person, who might be killed by witchcraft, or get infused with “panema”, incapacity to fish and hunt (SLATER, 1994; DUTRA & BARBI, 2014). Thus, the low consumption of boto’s meat might be interpreted as a food taboo which helps to conserve river dolphin populations in the Middle Tapajós.

In our study, four respondents stated that while they apparently do not use boto for any purpose, they knew of the use of the animal’s eye as an amulet to attract a lover. According to Da Silva (1990), the most important parts of boto have traditionally been the eyes and the genitals. In some areas of the Amazon it is believed that no one can resist the look of the boto (SLATER, 1994), and using the animal’s genitals – either the penis or the vagina – is considered very powerful as a sexual enhancer (CRAVALHO, 1999), giving great potency and sexual pleasure.

All respondents described boto as negatively affecting fishing practices. Three main problems were mentioned: a) getting caught in fishing nets (n=15 - 34.1%); destroying/tearing fishing nets (n=15 - 34.1%); and stealing fish from the net (n=14 - 31.8%).

By damaging fishing nets (Figure 3), botos cause economic losses to fishermen, given the fact that these nets need to be fixed or replaced. According to Read (2008), damage to fish captured in fishing nets may cause a decrease on fish prices affecting its commercialization, which is known to be a source of conflict between fishermen and river dolphins. The incidental capture of cetaceans in fishing nets has also been reported in the Northern, North-eastern, South-eastern and Southern Brazil (SIMÕES-LOPES & XIMENEZ, 1990; PRZBYLSKI & MONTEIRO-FILHO, 2001; SOUZA & BEGOSSI, 2007; LOCH et al., 2009; ZAPPES et al., 2009, 2013).



Figure 3. Fisherman demonstrating fishing net damaged by boto.

Even without been asked, seven respondents stated that, if they find a live boto trapped in fishing net, they set the animal free. In a study conducted in the region of Manacapuru, Amazonas, Alves et al. (2012) reported that 25% of interviewed fishermen released botos caught in fishing nets, while another 50% killed them.

3.3 Boto conservation

Although only one person (5.0%) cited gillnets as a threat to boto, the incidental capture of cetaceans in fishing nets is considered the main cause of negative interactions between humans and these river mammals (READ et al., 2006; READ, 2008; THOMPSON et al., 2013). It is possible that many of the fishermen did not mention the accidental capture in fishing nets as threats to the botos population as well as the retaliation for the damage caused, because such testimonies are a controversial subject and can attract the attention of environmental law-enforcement agencies such as the IBAMA, the Brazilian agency for environment protection.

When asked whether botos were important in nature, most respondents (85.0%) said “yes”, two (10.0%) said “no”, and one (10.0%) was unsure. Contrary to these findings, in Alves et al. (2012) study, most fishermen (68.7%) responded negatively when asked whether protecting boto was important. This suggested that, despite the mentioned losses, fishermen from the Middle Tapajós River show empathy for dolphins, which can be used to encourage environmental education and conservation activities in the region.

The reason given most frequently by respondents for the importance of boto relates to the fact that they assist in fishing (21.73%), pushing the fish toward capture nets, which could explain perceptions on the importance of dolphins, among other values and beliefs associated with this animal. Positive interactions involving fishermen and dolphins were also reported by Brito (2012) for the municipalities of Colares and Soure, Pará. Other studies, conducted mainly along marine coastal areas in Brazil, have documented collaboration between small cetaceans and fishermen, with dolphins directing fish schools toward sites where fishing nets were set (SIMÕES-LOPES, 1991; SIMÕES-LOPES et al., 1998; PRZBYLSKI & MONTEIRO-Filho, 2001; PETERSON et al., 2008; ZAPPES et al., 2011).

Among the fishermen who said that boto assists in fishing, sixty percent mentioned that during night fishing, the dolphins push the fish to the riverbanks or to rocky areas, allowing the fishermen to cast their tridents with greater chance of success. According to Atem and Monteiro-Filho (2006), some periods during the night are used by dolphins to enhance the activity of fishing, as some schools move in accordance with tide flows.

Most interviewed fishermen stated that there are no threats to botos in the Middle Tapajós region (Table 2). Of those who considered the boto to be imperiled, hydroelectric dam construction was the most cited threat (30.7%). One fisherman mentioned that the construction of hydroelectric dams threatens boto because it causes spawning fish to

disappear.

Main threats to the botos	N of descriptions	% of descriptions	% of interviewees
No threats	14	53.84	70.00
Dam construction	8	30.76	40.00
Gillnets	1	3.84	5.00
Retaliation for losses in fishing	1	3.84	5.00
Pump use	1	3.84	5.00
Do not know	1	3.84	5.00
Sum	26	100	-----

Table 2. Main threats to the botos in the region, according to respondents in the Middle Tapajós River, Pará, Brazil.

In the Brazilian Amazon, construction of >50 large and \approx 170 medium and small dams, on tributaries of the Amazon River are underway as a result of governmental plans geared toward increased economic growth and industrialization (SOARES-FILHO et al., 2005; FEARNSSIDE, 2015a). In the Tapajós River the dam complex will consist of five hydroelectric plants, three of which (São Luís, Cachoeira do Caí and Jatobá) would directly impact the Pimental and Vila Rayol communities. Based on what has happened at other hydropower installations in the Amazon basin, this complex would affect the hydrological dynamics, habitats used by human populations, and impact various groups of aquatic fauna, especially the fish community and river dolphins, restricting their movements and degrading their habitats (BEST & DA SILVA, 1989). Pavanato et al. (2016) conducted an estimative of density and abundance of boto and tucuxi and mapped their distribution in the Tapajós River, concluding that boto may not be sustainable at a population level, due primarily to population fragmentation which would result from the construction of the proposed dams.

3.4 Conservation strategies and recommendations

It is necessary to promote studies on the feeding ecology and map critical feeding areas used by the botos, comparing them to the main areas used by fishermen for fishing activities. Probably, the main conflicts and accidental catch of botos by fishermen occur in overlapping areas used by both botos and fishermen to feed and fish. Seeking to mitigate the impact of botos bycatch in fishing nets, changes in techniques and fishing equipment should be encouraged among fishermen. We consider that it is critically important to develop participatory research and monitoring activities in conjunction with the fishermen, since they need to be involved in the implementation and dissemination

of these changes. Traditional knowledge and practices should also be considered, and more effective solutions can be found with fishermen participation and ownership of the process.

Brazilian governments' decision to explore the hydroelectric potential of Amazonian rivers has transformed the state itself in one of the major threats to biodiversity and local livelihoods. Fishermen from Pimental and Vila Rayol communities, in the Middle Tapajós River, hold important knowledge to inform research, management and conservation of river dolphins, including detailed information of aspects of the food chain, habitat use, threats, and interactions with fishing activities. In the Middle Tapajós, the São Luís, Cachoeira do Caí and Jatobá big hydroelectric dams will directly affect the local aquatic fauna and fishing activities by residents of the communities studied. Management and conservation strategies to protect boto populations in the region should include research efforts and monitoring of patterns of variation in fish and dolphins' populations. Monitoring programs should obtain and analyze information on the occurrence, distribution, reproduction, population structure and genetics of animals in the reservoir area, as well as on up-river and down-river stretches.

Given the fact that many fishermen have a negative perception regarding the boto, we recommend the development of a regional participatory environmental education program, aimed at increased understanding of the importance of botos in the ecosystem, as well as to valuing local knowledge and traditions related to the species. It is also essential to consider future changes in the demographics of the region, which will promote the increased pressure on fisheries resources. For Tucuruí and Belo Monte, two other hydroelectric plants located in the state of Pará, studies recorded increased pressure on fisheries resources due to higher population density and related fishing activities during the stages of dam planning and construction (CAMARGO & PETRERE JR., 2004; CINTRA et al., 2013; SANTANA et al., 2014). Alternative economic activities that can enhance appreciation and conservation of boto populations in the region could also be developed, such as ecotourism, through mapping and identification of areas with potential for watching of boto and other fluvial mammals.

4 | CONCLUSIONS

Fishermen in the Middle Tapajós River hold detailed knowledge on boto biology and ecology, including their interaction with fish species. The consideration of local fishermen knowledge to complement existing scientific knowledge may contribute to the design and implementation of strategies for management and conservation of boto and to the maintenance of artisanal fishing in the Middle Tapajós region.

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